Experimental Investigation for a Human Relationship Formation Support Agent using Information Presentation During Conversation

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Keywords: Communication Support Agent, Information Presentation, Intelligent User Interface.

Abstract: In this paper, we performed an experimental investigation aimed at developing an agent to support the formation of human relationships by supporting the user's daily communication "casually", "anytime" and "anywhere". First, we collected conversations between men and women meeting for the first time, then analyzed what type of support would be effective for the formation of human relationships. Based on the results of this analysis, we performed experiments supporting communication. In the experiment, we provided not only topics to the user during conversation, but also comprehensive presentation of instructions such as expressions, eye contact and gestures. The results confirmed that this significantly improved human relationships after conversation and showed the validity of this support.

1 INTRODUCTION

Our goal is to realize an agent that will grasp the communication state of a supported user and his or her conversation partner in real-time and offer advice to the user through a wearable device. Studies to support communication have been performed widely. However, these have been extremely limited in terms of use conditions, requiring large equipment or displays or for the conversation participants to wear specialized devices such as sensors. The objective of this study is to support the formation of human relationships by supporting the user's daily communication "casually", "anytime" and "anywhere".

This study does not suppose any specialized situations, such as the conversation partner using a particular device or being equipped with sensors. Only the supported user wears the required device, and support is given independent of situation or location. Moreover, the system provides not only topics to the user during conversation, but also includes comprehensive presentation of instructions such as expressions, eye contact and gestures. We aim to realize an agent that makes it possible to promote better human relationship formation through those presentations.

However, it is not necessarily clear what types of content would be effective to present to the user, or that it would be possible for such a system to promote the formation of good human relationships. Thus, in this study we collect data from conversations between men and women meeting for the first time and perform analysis to find effective support content. Then, we perform experiments that present the support content to the user during communication. In this study, however, we do not target situational recognition during communication, but have a person to choose the content and timing to be presented in the experiment. We then assess the content presented to the user and the effectiveness of support during communication from the perspective of forming better human relationships. Also, in this study we viewed mutual interpersonal impressions as a human relationship, and examined the effectiveness of promoting human relationship formation by determining how much interpersonal impressions of conversations partners improved during conversation.

Participants answered a survey covering a number of impressions before and after the conversation, and data was collected on the changes. Next, we analyzed how the conversations related to changes in impressions. Through this analysis, we determined the content to present. Finally, we performed an experiment to support communication by presenting the content determined through the analysis to a user. However, we do not target situational recognition during communication, rather having a person to choose the content and timing to be presented.

Inaba, M., Otsuka, K. and Takahashi, K.
Experimental Investigation for a Human Relationship Formation Support Agent using Information Presentation During Conversation.
DOI: 10.5220/0005643200870094
In *Proceedings of the 8th International Conference on Agents and Artificial Intelligence (ICAART 2016) - Volume 1*, pages 87-94
ISBN: 978-989-758-172-4

2 RELATED RESEARCH

A number of studies that present information to conversation participants in order to support face-to-face communication are being carried out.

Research on supporting communication through the presenting information on a display or other device includes the Ambient Suite information environment proposed by Fujita et al. to support communication between multiple people (Fujita et al., 2011). Ambient Suite is a system that estimates the state of the conversation using multiple sensor attached to the participants and displays photographs or other information on displays placed on the walls or floor. Multiple studies to support communication in meetings and similar environments by visualizing elements such as talk time, gaze and head movement are also being performed (Madan et al., 2004; Sturm et al., 2007). Kim et al. proposed Meeting Mediator, which supports balanced discussions by visualizing participant talk amounts on portable terminals during meetings (Kim et al., 2008). Ticket2Talk, proposed by Mccarthy et al., is a system that displays the area of expertise of conference participants standing near a display using RFID tags(McCarthy et al., 2004). Other studies include a method to present information related to conversation participants by attaching miniature displays, such as badges (Borovoy et al., 1998) and a method to present information in informal spaces such as break rooms (Matsuda and Nishimoto, 2002).

However, the systems in these studies place major restriction on the place and situation in which they can be used, such as requiring large devices or participants wearing sensors or RFID tags. In addition, support effectiveness is assessed through increases in conversation (Fujita et al., 2011; Matsuda and Nishimoto, 2002) or satisfaction (Kim et al., 2008; McCarthy et al., 2004). We are not aware of any studies which treat promoting the formation of human relationships as the main objective and perform analysis from that aspect.

3 COLLECTION AND ANNOTATION OF CONVERSATION DATA

In this study, we first collected conversation data for determining the instruction content to be presented to the user. The collected data was taken at fifteen-minute intervals from a male and female meeting for the first time. Questionnaire surveys were conducted immediately before and after the conversation.

In this chapter, we talk about the conversation data collection method and questionnaire content.

3.1 Collection Method

In this study, we collected data from conversations between unacquainted males and females meeting for the first time. This type of conversation was chosen in order to make it easier to analyze the relationship with the actual communication carried out by starting with a situation in which human relationships were not yet formed, then observing what type of relationship was formed after the the conversation ended. We also considered that using conversations between males and females would more easily show differences in regards to conversation liveliness and participant attitude in comparison with conversations between two members of the same gender.

The conversation collection procedure is as follows. First, participants were moved from waiting rooms, which were divided by gender, to a room for collection. The participants sat across from one another at a table. Upon a signal from an operator, participants greeted one another and gave self introductions. Afterwards, the participants returned to their waiting rooms and answered a pre-conversation survey. After answering the survey, both participants returned to the collection room and sat down once again. At a signal from the operator, they began a conversation lasting for fifteen minutes. No restrictions, instructions or proposals were given for the topics or content discussed by the participants; they were only told to converse for fifteen minutes. After the conversation, each participant moved to another room where he or she answered a post-conversation survey.

3.2 Survey

In order to grasp changes in the relationship between the participants before and after the conversation, participant personalities and characteristics, and conversation conditions, we gave surveys before and after the fifteen-minute conversation. The content of these surveys are described below.

3.2.1 Pre-conversation Survey

The pre-conversation survey was composed of two items using an eight-step Lickert scale (1: very good, 8: not good at all). Survey items are shown below.

[Eight-step Survey Items]

Q1. Do you have a good impression of your conversation partner?

Q2. Are you good at small talk?

The first eight-step item, Q1, is a question to survey the participant's impression of his or her partner. The second, Q2, is a question to survey the participant's conversation ability.

3.2.2 Post-conversation Survey

The post-conversation survey was composed of three items: two eight-step Lickert scale items (1: very good, 8: not good at all) and one free writing question. The survey items are shown below.

[Eight-step Survey Items]

Q1. Do you have a good current impression of your conversation partner?

Q2. Did the conversation go well?

[Free Writing Item]

Q3. Please write down anything that you noticed in particular.

The first eight-step item, Q1, is a question to examine the participant's impression of his or her partner. The second, Q2, is a question to survey his or her impression of the conversation itself. The free writing item, Q3, is a question to survey anything the participant noticed during the conversation.

3.3 Collection Results

The participants consisted of a total of 26 college students, graduate students and high school students (13 males: average age 21.92, 13 females: average age 21.46, overall: average age 21:69). A total of 23 conversations were carried out.

Table 1 shows the results of the pre-conversation survey conducted together with conversation data collection, and Table 2 shows the results of the post-conversation survey. Comparing the average values for the question "Do you have a good impression of your conversation partner?" before the conversation and "Do you have a good current impression of your conversation partner?" after the conversation, we find that the value increased by 0.72. Thus, we find that conversations tended to improve impressions.

Looking at the question "Are you good at small talk?", which examines the participant's own conversation ability, we see that the average value of 4.58 fell roughly in the center of the eight-step scale. The variance was also larger in comparison with other items, showing that the participants included both those who were skilled at conversation and those who were not. In the "Did the conversation go well?" question in the post-conversation survey, we find a positive result with an average of 2.57. This suggests that conversations tended to go well overall.

Table 1: Pre-conversation survey results (conversation data collection).

	Survey item	Average	Variance
Q1	Do you have a good impression of your conversation partner?	2.59	1.05
Q2	Are you good at small talk?	4.58	3.69

Table 2: Post-conversation survey results (conversation data collection).

	Survey item	Average	Variance
Q1	Do you have a good current impression of your conversation partner?	1.87	0.52
Q2	Did the conversation go well?	2.57	1.67

3.4 Instruction Content

Based on analysis of the collected conversation data and our literature review, we determined content to be presented to a target user for communication support. Table 3 shows the instruction content we determined. The line "(2 from Topics A)" seen in 3, 5, 6, 7 and 9 of the table indicate choosing and displaying the specified number of topics from those given in Table 4. For example, the instruction content of 3 in Table 3 proposes "Ask your partner about his or her plans "Christmas" "Travel" ".

Below, we given our reasons for determining each instruction content. Instruction contents 1 to 9 were determined based on the determination made from the results of the analysis of the collected conversation data, i.e. that if the participants who become the speaker and listener, respectively, actively pursue their own respective roles, this tends to improve impressions. In addition, instruction contents 1 to 4 are intended to support a listener in moving the conversation forward, while 5 to 9 are intended to support a speaker. The topics in Table 4 were determined with reference to the list of topics for initial conversations between college students given by Mimaki (Mimaki, 2013).

Instruction content 10 is to be given in situations in a conversation when the participant can nod, based

Table 3: Instruction content.

No.	Content
1	Ask your partner “What about you?” or “What do you think?”
2	Ask for a reason
3	Ask your partner about his or her plans (2 from Topics A)
4	Ask your partner about him/herself “Hometown”, “Hobbies, recent interests”, “Siblings”
5	Let your partner speak about the following topic (3 from Topics B)
6	Talk about yourself (2 from Topics C)
7	Talk about your own plans (2 from Topics A)
8	Talk about your own experiences “Part-time job”, “Travel”, “Club activities”
9	Talk about one of the following topics connecting with yourself (3 from Topics B)
10	Nod in agreement with your partner
11	Respond with “I see” or “Yes, that’s true”
12	Do not cover your hand with your face
13	Do not put your elbows up
14	Do not touch your hair
15	Do not cross your arms
16	Try to smile
17	Talk about the following topics to find common points with your partner “Hobbies”, “Sports”, “Favorite music”, “Hometown”
18	Look your partner in the eye and speak
19	Try to maintain good posture
20	Try to maintain a bright tone of voice

Table 4: Topics to present.

Topics A	Christmas, Travel, New Year’s Eve, New Year’s Day, End-of-year cleaning
Topics B	TV, Pro baseball, School, Movies, J-League soccer, Studies, Video games, Food, Sports
Topics C	Hometown, Hobbies/current interests, siblings, recent events

on the analysis results, in which it was determined that more nodding tended to improve impressions. Instruction content 11 is also meant to indicate to the partner that one is listening, as with nodding. Instruction contents 12 to 15 were determined from the analysis results, which determined that touching hair or crossing arms can harm one’s impression. Instruction content 16 is given based on the analysis, in which it was determined that smiling tended to improve impressions.

Instruction content 17 was determined to make it easier to discover common points with one’s partner, as the free writing section of the post-conversation survey included multiple opinions such as “the conversation went well because we were able to find common points”, and in these cases impressions improved.

Instruction contents 18 to 20 are given to give a better impression to one’s partner.

4 CONVERSATION SUPPORT THROUGH INFORMATION INSTRUCTIONS

In this chapter, we perform an experiment in which we support a conversation by teaching the participants information. We then compare these with conversations without instructions to determine whether they were able to form better human relationships. Following the procedure of the data collection experiment conducted in Chapter 3, males and females meeting for the first time conducted fifteen-minute conversations with pre-conversation and post-conversation surveys.

During the experiment, one of the two participants received information. The information was presented using a projector and screen. This was done because we believed it would be best to avoid wearing any special apparatus and to simulate the conditions of the conversation collection experiment in Chapter 3 as closely as possible. The content and timing of the content shown on the screen was determined manually. In this experiment, an operator determines the state of the conversation and decides the content to display.

4.1 Instruction Method

Instructions were presented using a projector and screen. While sounds could be used to convey instructions in addition to visual cues, this could make it more difficult to concentrate on the conversation, so in this experiment we gave instructions using a projector and screen.

Figure 1 shows an outline of the experiment environment. Of the two participants shown in the figure, one is the instructed participant, who will receive conversation support in the form of instructional information, and the other is the non-instructed participant, who will not receive support. The two participants sit across a table from one another and conduct a conver-

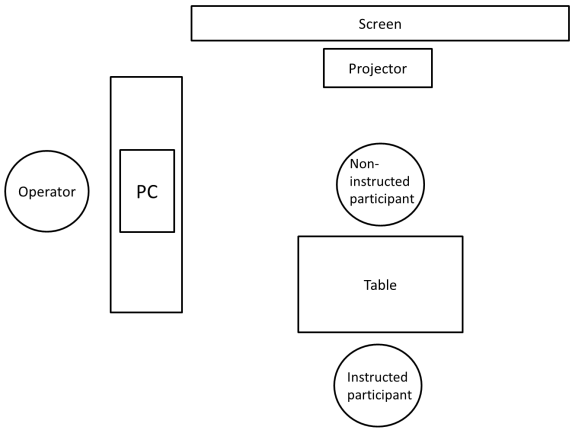

Figure 1: Experiment environment orientation.

Figure 2: Screen display examples (translated by authors).

sation. A project and screen are set up behind the non-instructed participant. In this manner, instructions are presented only to the instructed participant. The operator is seated in a position that allows him or her to see the expressions and movements of the instructed participant.

The operator observes the conversation content as well as the actions and attitude of the participants and displays instructions suitable to the conditions on the screen by operating a PC connected to the projector. Figure 2 gives four examples of information displayed to the screen (Original instructions are written in Japanese only). Text is displayed on the top half of the screen to make it easier to see over the conversation partner.

When the conversation begins, topics for finding common points are presented (17 in Table 3). From then on, the operator determines the content and timing of the displayed information based on the following basic guideline.

- Provide topics during periods of silence (4, 6, etc. in Table 3)
- Point out issues with the participant (12, 13, etc. in Table 3)
- Promote responses (10, 11, etc. in Table3)
- In cases when there is little need for support, such as when the conversation is going well, display 16, 18, 19, 20 in Table 3 in order.

Instruction content does not disappear from the screen until the next instruction content is displayed. In other words, the screen is always displaying some information until the conversation ends. However, the operator gave new content for display at least once per minute. The same instruction was not given twice in a row.

As a result of the analysis, we determined that listeners and speakers should concentrate on their respective roles. Thus, we determined whether the instructed participant was a listener or a speaker and changed instruction content accordingly. As described in the previous section, 1 to 4 in Table 3 correspond with listener instructions, while 5 to 9 correspond with speaker instructions. The determination of whether the participant was a speaker or a listener was made by the operator during roughly the first minute of the conversation.

4.2 Experiment Method

The experiment was conducted with male and female participants meeting for the first time. Participants were composed of a total of 20 college and graduate students (10 males: average age 22.10, 10 females: average age 22.00, overall: average age 22.05). A total of 20 conversations were conducted. Each participant conducted conversations with two members of the opposite gender. In one of these conversations the participant received instruction, while in the other he or she did not receive instruction (while his or her partner received information).

The experiment procedure followed that of the conversation data collection experiment described in Section 3.1. In other words, participants greeted one another, performed self introductions, completed pre-conversation surveys, conducted a fifteen-minute conversation, and completed post-conversation surveys in that order. However, in this experiment we explained the instruction method and content to both the instructed participant and non-instructed participant before greetings and self-introductions. This information was also explained to the non-instructed participant in order to prevent conditions in which the participant became concerned with what was displayed on the screen and could not concentrate on the conversation. Instructed participants were told that while they

did not have to follow all instructions if the actions or conversation felt unnatural, they should follow the instructions as closely as possible.

4.3 Surveys

The pre-conversation survey was identical to that given in the conversation data collection experiment in Section 3.2.1. Both instructed participants and non-instructed participants used the same pre-conversation survey, but each answered different surveys after the experiment. In addition to the post-conversation survey explained below, the instructed participant also completed a survey examining the utility of the instruction content. This was performed by giving the instructed participant a list of the instruction content shown on the screen and having him or her mark which items were useful and which were not (with multiple answers acceptable).

4.3.1 Post-conversation Survey for Instructed Participants

The post-conversation survey for instructed participants consisted of eight eight-step Lickert scale items (e.g. 1: strongly agree, 8: strongly disagree), one ten-step Lickert scale item (1: 10%, 10: 100%), and two free writing items. Survey items are shown below.

[Eight-step Survey Items]

Q1. Do you have a good current impression of your conversation partner?

Q2. Did the conversation go well?

Q3. Was the instruction timing good?

Q4. Were the text position, size and color good?

Q5. Were the instructions useful for smoothly moving the conversation forward?

Q6. Were the instructions useful for making the conversation go well?

Q7. Were the pointers and advice for attitude and behavior (e.g. “Try to smile” or “Nod”) useful?

Q8. Overall, were the instructions useful?

[Ten-step Survey Item]

Q9. To what extent were you able to utilize the conversation support contents?

[Free Writing Items]

Q10. Please writing any positive points about the instructions

Q11. Please writing any points about the instructions that need improvement

Of these, Q1 and Q2 are the same as those used in conversation data collection. Q3 to Q8 are used to assess the instructions from the instructed participant’s point of view. The single ten-step item is used to survey how much the participant followed the instructions. Free writing items Q10 and Q11 are used to survey opinions related to instructions given during conversation.

4.3.2 Post-conversation Survey for Non-instructed Participants

The survey for non-instructed participants was composed of three eight-step Lickert scale items. The survey items are shown below.

[Eight-step Survey Items]

Q1. Do you have a good current impression of your conversation partner?

Q2. Do you think the conversation went well?

Q3. Did you feel any unease about your conversation partner being supported?

Of these, Q1 and Q2 are the same as those used in the conversation data collection experiment. Q3 is used to assess the instructions from the non-instructed participant’s point of view.

4.4 Experiment Results and Discussion

Table 5 shows the result of the pre-conversation survey, Table 6 shows the results of the instructed participant post-conversation survey, and Table 7 shows the results of the non-instructed participant post-conversation survey. Instructions were shown an average of 15.1 times during conversation.

In Q2 “Are you good at small talk?” of Table 5, the average value is 4.50. As with the conversation data collection experiment, participants both good and bad at small talk participated. In Q9 of Table 6, the utilization of the instruction contents was about 60

Q3 in Table 7 shows that non-instructed participants felt little discomfort about their partners receiving instructions. This suggests that the visual presentation method was suitable.

4.4.1 Changes in Impression Due to the Presence of Instructions

As with the data analysis, we examined the change in partner impression by looking at the variance be-

Table 5: Pre-conversation survey results (conversation support experiment).

	Survey item	Ratio	Variance
Q1	Do you have a good impression of your conversation partner?	3.00	1.33
Q2	Are you good at small talk?	4.50	3.74

Table 6: Results of post-conversation survey for instructed participants (conversation support experiment).

	Survey item	Ratio	Variance
Q1	Do you have a good current impression of your conversation partner?	2.10	1.57
Q2	Do you think the conversation went well?	3.05	2.79
Q3	Was the instruction timing good?	3.30	1.59
Q4	Were the text position, size and color good?	2.30	1.38
Q5	Were the instructions useful for smoothly moving the conversation forward?	2.95	1.84
Q6	Were the instructions useful for making the conversation go well?	3.20	2.59
Q7	Were the pointers and advice for attitude and behavior (e.g. “Try to smile” or “Nod”) useful?	2.95	1.21
Q8	Overall, were the instructions useful?	3.05	1.63
Q9	To what extent were you able to utilize the conversation support contents?	6.30	6.64

tween the answer to the eight-step item Q1 in the pre-conversation survey and the answer to the eight-step item Q1 in the post-conversation survey. As seen in Tables 5 through 7, the average changes in impression for participants were 0.70 for non-instructed participants and 1.15 for instructed participants. The average value for changes in impression in the data collection experiment in Chapter 3 was 0.72 [1].

These results show that the impression of instructed participants improved greatly in comparison with participants in the conversation data collection experiment and non-instructed participants in this experiment. In addition, a t-test confirmed a significant difference with both with a significance level of 5%. Thus, this shows that the impressions of instructed participants improve significantly in comparison with non-instructed participants. Thus, we were able to confirm that conversation support through instructions is useful for enlivening conversation and obtaining better impressions from others.

[1]Participants in the conversation data collection experiment can also be viewed as non-instructed participants.

Table 7: Results of post-conversation survey for non-instructed participants (conversation support experiment).

	Survey item	Ratio	Variance
Q1	Do you have a good current impression of your conversation partner?	2.05	0.37
Q2	Do you think the conversation went well?	2.35	0.87
Q3	Did you feel any unease about your conversation partner being supported?	5.85	2.13

4.4.2 Effectiveness of Conversation Support Through Information Presentation

Survey results for Q5 to Q8 of Table 6 give assessments of approximately 3.0 for instructions helping to smoothly move conversations forward, enlivening conversations and helping to face conversations with better attitudes and behaviors. We obtained good results for other subjective assessments from the instructed participants as well.

In addition, in analyzing the free writing survey, we found opinions from participants that answered that the instructions were useful included that topic support “was good because I was given topics when I couldn’t think of any”, and that “the conversation started smoothly because the first topic was provided”. There were also opinions about the indications and advice for attitude and behavior, including “I was nervous about talking with someone I was meeting for the first time, but the indications about behavior helped me to smile”.

4.4.3 Instruction Content Assessment

Table 8 shows the results of the survey related to the usefulness of instruction content conducted simultaneously with the post-conversation survey. The table shows ratios of participants who answered that instructions were helpful or not helpful for seven in-

Table 8: Instruction content usefulness assessment results.

Instruction content	Ratio of useful determinations	Ratio of non-useful determinations
Ask your partner about him/herself “Hometown”, “Hobbies, recent interests”, “Siblings”	0.90	0.00
Look your partner in the eye and speak	0.80	0.00
Try to maintain good posture	0.70	0.05
Try to smile	0.65	0.10
Nod in agreement with your partner	0.60	0.05
Respond with “I see” or “Yes, that’s true”	0.50	0.00
Try to maintain a bright tone of voice	0.40	0.15

struction content items that were shown during ten or more (half of the total) conversations.

In the table, six items were determined to be useful by a ratio of more than 0.50 of participants. Ratios of participants answering that these same six items were not useful were less than 0.10.

On the other hand, the instruction to brighten one’s town of voice had the lowest ratio of participants who found it useful at 0.50, and the highest ratio of participants who did not find it to be useful at 0.15, the highest of the seven items. It may be that because suddenly raising one’s voice would be unnatural, and many participants found this difficult to utilize, making it less useful. Thus, we must examine changing expressions or giving more specific instructions for raising the tone of one’s voice.

5 CONCLUSION

In this study, we aimed to construct a system that would allow promoting the formation of human relationships through displaying information to a user, and showed instruction content and the usefulness of conversation support through information presentation experimentally.

We first collected conversation data between two people meeting for the first time.Next, we analyzed the conversation and using the knowledge gained from the results of the analysis, we determined content that should be presented to the user in order to give his or her partner a good impression. Finally, upon conducting an experiment supporting conversation through presenting information to a user during conversation, we confirmed that these instructions significantly improved the impression of the user’s partner compared with users that did not receive instruction.

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